2004 GREATER LAKE WASHINGTON CHINOOK WORKSHOP
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Status of Coupled Ecological Model - Water Velocity/Quality and Adult Chinook
Behavior at the Locks — Fred Goetz

Adult salmon hold at the Locks for up to 47 days in a small-localized area immediately upstream of the Locks with unknown effect on reproductive success. Initial hypotheses have been developed to address this situation: 1) high water temperatures (and/or low dissolved oxygen) further upstream of the Locks are a barrier that adults will not swim through; 2) the area immediately upstream (within 1000 ft) of the Locks is a necessary cool water refuge where adults can safely hold until temperatures drop; and 3) what series of lock operations or changes in the structural configuration of the Locks that can improve the quality (velocity, dissolved oxygen, temperature, salinity) of the cool water refuge. An experimental study was conducted in 2000 using a series of lock operation settings to provide data to explore the second and third hypotheses. Adult chinook salmon behavior (using the HTI linked hydrophone array) and water quality conditions were monitored during the operational testing and will be reviewed for reference.

Studies on adult chinook salmon have followed the example set by our juvenile studies. We used a pilot technology (a linked hydrophone array) to accurately track adult chinook in a very small-localized area. Adult studies have moved beyond actual physical testing and monitoring of results and are attempting to employ ecological modeling as an adaptive evaluation tool. To evaluate the monitoring data a coupled ecological model linking a hydrodynamic model (computational fluid dynamics (CFD) model) of the Ship Canal and a fish behavior (numerical fish surrogate -NFS) model is being developed by the University of Iowa and the Corps Engineering Research and Design Center. This model can be used to further explore the monitoring data (fish behavior in response to environmental change), evaluate the hypotheses, and to test and evaluate new scenarios of Lock operations or structural changes.

Work on the Locks model in 2004 will include statistically relating the behavior of adult salmon in the Chittenden Locks to patterns in flow, temperature, and salinity (DO might be added to the model). The model can then be used to quantitatively evaluate each possible operational scenario or structural design alternative considered for the Locks by using virtual fish programmed to respond according to rules uncovered during the system analysis of the integrated data sets. This latter step has only been achieved at a reasonable level in one other project (Lower Granite Dam) so there is some uncertainty as to the success for the Chittenden Locks. However, if successful, this would take much of the uncertainty out of salmon restoration activities that involve major hydraulic redesign or changes in water management practices. Data will be presented that illustrate adult migratory behavior at the project with some initial plots of the coupled ecological model. Beyond 2004, future work will include addition of juvenile salmon monitoring behavior to the coupled ecological model-allowing scenario testing of both adult and juvenile salmon under different structural and operational conditions.